CLAIMS

What is claimed is:

1. A microfluidic structure comprising:

a first surface including a pneumatic channel;

a second surface including a fluidic channel; and

an elastomer membrane located between the first and second surfaces such that the application of a pressure or a vacuum to the pneumatic channel causes the membrane to deflect to modulate a flow of a fluid in the fluidic channel.

2. The microfluidic structure of claim 1, wherein the first and second surfaces are glass, plastic, polymer.

3. The microfluidic structure of claim 1, wherein the membrane is gas permeable.

4. The microfluidic structure of claim 1, further comprising additional surfaces and membranes.

5. The microfluidic structure of claim 4, wherein the additional surfaces have additional channels to provide paths for fluid flow.

6. The microfluidic structure of claim 1, wherein the second surface includes a plurality of vias operable to provide paths for fluid flow.

7. The microfluidic structure of claim 1 configured as part of a pump, the comprising a plurality of valves implemented using the elastomer membrane.

8. The microfluidic structure of claim 7, wherein the pump is used to form a multi-directional fluidic router.

9. The microfluidic structure of claim 1 placed in a loop and configured as part of a mixer.

10. The microfluidic structure of claim 1 placed in a series and configured as a mixer, wherein mixing is accomplished by moving fluid between two chambers.

11. The microfluidic structure of claim 1 configured as part of a reservoir.

12. The microfluidic structure of claim 11, wherein mixing is accomplished by moving a fluid between two reservoirs.

13. The microfluidic structure of claim 11, wherein multiple reservoirs are connected by a fluidic bus.

14. The microfluidic structure of claim 11, wherein the reservoir has one or more inputs and is operable as a reactor.

15. The microfluidic structure of claim 1, wherein the membrane normally prevents the flow of a fluid in the fluidic channel, the application of a vacuum to the pneumatic channel causing the membrane to deflect to allow the flow of a fluid in the fluidic channel.

16. A microfluidic structure comprising:

a first surface including a pneumatic channel;

a second surface including a plurality of vias;

a third surface including a fluidic channel; and

an elastomer membrane located between the first and second surfaces such that the application of a pressure or a vacuum to the pneumatic channel causes the membrane to deflect to modulate a flow of a fluid in the fluidic channel.

17. The microfluidic structure of claim 16, wherein the first, second, and third surfaces are glass, plastic, or polymer.

18. A microfluidic structure comprising:

means for allowing flow of a fluid on a first layer;

means for modulating the flow of the fluid on the first layer using the application of a pneumatic pressure or vacuum to control an area of a membrane coupled to the first layer.

19. A microfluidic device, comprising:

a chemically compatible layer, the chemically compatible layer having a plurality of channels, the channels operable to provide paths for fluid flow; and

a membrane layer coupled to the chemically compatible layer, wherein applying pneumatic pressure to regions of the membrane layer is operable to actuate a plurality of pneumatically switchable valves, wherein the pneumatically switchable valves are operable to control fluid flow on the microfluidic device.

20. The microflulidic device of claim 19, wherein the chemically compatible layer is a glass, plastic, or polymer layer.

21. The microfluidic device of claim 20, further comprising a pneumatic layer, the pneumatic layer having a plurality of etched channels, the etched channels operable to distribute the pneumatic pressure to regions of the membrane layer.

22. The microfluidic device of claim 21, wherein the membrane layer is sandwiched between the glass layer and the pneumatic layer.

23. The microfluidic device of claim 19, wherein three pneumatically switchable valves in series is operable to form a pump.

24. The microfluidic device of claim 23, wherein the three valves include an input valve, a diaphragm valve, and an output valve.

25. The microfluidic device of claim 19, wherein four pneumatically switchable valves are operable to form a router.

26. The microfluidic device of claim 19, wherein pneumatically switchable valves are operable to form a mixer, wherein a fluid analyte is moved back an forth between chambers to allow mixing.

27. The microfluidic device of claim 22, wherein the pneumatic layer is glass.

28. The microfluidic device of claim 20, wherein the valves are closed when no pneumatic pressure is applied.

29. The microfluidic device of claim 20, wherein a single port supplying pneumatic pressure is operable to open multiple valves.

30. The microfluidic device of claim 29, wherein the glass layer includes immunocapture chambers operable to capture a target provided to the immunocapture chambers through etched channels.

31. The microfluidic device of claim 30, wherein the plurality of immunocapture chambers are configured to hold selected antibodies.

32. The microfluidic device of claim 31, wherein the selected antibodies are held with beads, frits, sol-gels, gels, or polymer monoliths.

33. The microfluidic device of claim 32, wherein the immunocapture chambers provide the target to DNA analysis mechanisms.

34. The microfluidic device of claim 33, wherein DNA analysis mechanisms include PCR and CE mechanisms integrated on the microfluidic device.

35. The microfluidic device of claim 19, wherein three valves are placed in a loop to form a mixer.

36. The microfluidic device of claim 19, wherein valves held in the open position are operable to function as reservoirs.

37. The microfluidic device of claim 19, wherein mixing is accomplished by moving a fluid between two reservoirs.

38. The microfluidic device of claim 19, wherein multiple reservoirs are connected by a fluidic bus to form a bus valve.

39. The microfluidic device of claim 36, wherein reservoirs with one or more inputs is operable as a reactor.

40. A method for controlling fluid flow on a microfluidic device, the method comprising:

opening an input valve and closing an output valve by varying pneumatic pressure to one or more regions of a membrane layer coupled to a glass layer, the glass layer having a plurality of etched channels, the etched channels operable to provide paths for fluid flow;

opening a diaphragm valve and closing the input valve by varying pneumatic pressure; and

opening the output valve and closing the diaphragm valve, wherein closing the diaphragm valve pumps analyte fluid through the open output valve.

41. The method of claim 40, wherein varying pneumatic pressure includes applying pressure or applying vacuum pressure.

42. The method of claim 40, wherein the microfluidic device comprises a pneumatic layer, the pneumatic layer having a plurality of etched channels, the etched channels operable to distribute the pneumatic pressure to regions of the membrane layer.

43. A microfluidic device, comprising:

means for opening an input valve and closing an output valve by varying pneumatic pressure to one or more regions of a membrane layer coupled to a glass layer, the glass layer having a plurality of etched channels, the etched channels operable to provide paths for fluid flow;

means for opening a diaphragm valve and closing the input valve by varying pneumatic pressure; and

means for opening the output valve and closing the diaphragm valve, wherein closing the diaphragm valve pumps analyte fluid through the open output valve.

44. The microfluidic device of claim 43, wherein varying pneumatic pressure includes applying pressure or applying vacuum pressure.